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DISQUISITIONS

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INFLUENCE OF SOIL AND CLIMATE,
In improving the Nourishing Quality of
VEGETABLES.

IN WHICH IT IS PROVED,

- I. That the quality of Malt does not depend so much upon the weight of the Barley as on the Soil and Climate in which it has been produced :

AND,

- II. That Malt of the growth of Scotland is much inferior to that of England, and other warmer Climates, or more fertile Soils.

By WILLIAM MACKIE Farmer at Ormiston.

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ADVERTISEMENT.

THE author of the following Disquisitions, before he had studied Chemistry, by attending to the effects of manure in promoting the growth of plants on his own farm, was strongly impressed with the idea, that a common nourishment supported the animal and vegetable creation. He is now convinced that that nourishment is the inflammable principle which chemists call *phlogiston*.

He intended to have treated this subject in a more copious manner ; but as a bill is soon to be brought into Parliament, which may perhaps give rise to investigations relative to the following Disquisitions, he submits them to the public in their present form.

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that this necessary ingredient does not depend so much on the size or weight of the particular vegetable, as on the soil and climate in which it is produced.

DISQUISITIONS, &c.

THE following Disquisitions tend to illustrate two objects: The first pointing out the causes which produce the essential ingredients necessary in barley for making rich malt; and, secondly, the impediments which prevent these materials from being extracted by the arts of brewing and distillation.

If it is allowed by chemists that the quantity of spirits which can be extracted from any vegetable substance by distillation must originally proceed from the quantity of saccharine matter which the plant contains, I shall endeavour to show that

that this necessary ingredient does not depend so much on the size or weight of the particular vegetable, as on the soil and climate in which it is produced.

Providence has bountifully stored up a common nourishment in the form of a saccharine juice, for the support of the animal creation, in the fruit, leaves, stems, and roots of most vegetables, and in a richer, more compacted, and different modification, in the seeds of most plants, which, if they do not contain a portion of sugar perceptible to the taste, are possessed of materials that compose it, and which is always produced whenever seeds begin to vegetate, and the young plants to expand, as in barley, wheat, or any other grain.

As a proof that the quantity of sugar contained in plants in a great measure depends upon the united influence of climate and richness of soil, the following illustrations are stated.

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The sugar cane, and those plants and fruits which contain saccharine juice in considerable quantities, are all of them natives of the torrid zone, or warm climates.

The plants produced in rich soils afford to the animals which feed upon them a great deal of more nourishment than those that grow upon land of a poorer quality. This circumstance, however, is not attended to by the purchasers of hay; it is nevertheless certain, that, when that article is produced on good soils, it apparently contains more oils, and other rich concreted juices, and resists the effects of bad weather in hay-making, much better than what grows upon poor soils, which always assumes the appearance of a plant that has been robbed of the greatest part of its phlogiston, by the influence of the sun and air having less colour, and being easily broke in pieces, like a rotten twig.

On

On some estates in the island of Jamaica an acre of sugar canes sometimes yields near double the quantity of sugar that an acre equally luxuriant in appearance will produce on another estate, owing to the superior richness of the soil.

In particular seasons, the planters in Jamaica are sometimes deceived with the appearance of a luxuriant crop, which, when it passes through the mill, affords but a scanty produce of sugar ; a proof that the quantity of that rich ingredient in the cane depends much on the influence of climate.

Plantations of sugar-canes, when exhausted by cropping, not only produce less sugar, but even the diminished quantity is of a very inferior quality. The quantity and quality, however, are again restored by applying manure to the roots of the canes.

The above observation will also hold in the cultivation of the vine. When the
soil

soil is exhausted, manure must be applied. In the city of Marseilles, the putrid animal and vegetable substances are carefully collected for enriching the vineyards. I am well aware that the manuring of vines may hurt the particular flavour of wines, the flavour as well as the various colours of vegetables, depending upon the nicest combinations of phlogiston, must be easily deranged : But, although the wine may have undergone a change of flavour, owing to the vines imbibing a larger quantity of phlogiston from the richly manured soil, nevertheless, the wine will in consequence thereof probably contain a larger portion of saccharine matter. A native of Hungary informed me, that in the canton of Tokay every third or fourth year pits are dug in the ground, which are filled to a certain height with rich well-digested manure ; the soil is then put in, and the vines planted : It is well known, that the wine produced in that province is held in the highest estimation.

Particular provinces in France, and even particular vineyards in these provinces, produce much better wine than others. Wines of certain vintages are held in estimation, whilst those of others are much inferior. The difference in the quality of the wine certainly cannot depend on the size or weight of the grapes, but on the quantity of saccharine juice which they contain.

Let these vines be transplanted into England, and their grapes will perhaps prove as four to the taste as the sloe or the barberry.

A certain weight of grapes produced in England will most undoubtedly yield a great deal less brandy by distillation, than an equal weight of grapes produced in France.

Let an onion or a cabbage be carried from England, and planted in Portugal;

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an apple tree to France, or a potatoe to the West Indies, and they will all of them contain a great deal more saccharine juice than in England.

The pastures of England certainly afford more nourishment to the cattle which feed upon them than the pastures of Scotland. It is always observed, that the grass which springs up in cold, moist, cloudy seasons, is not near so nourishing as what grows in dry, warm, sunny weather, the cattle always fattening better, although in appearance they do not procure such quantities of food. Butter and cheese made in Scotland are in general much inferior to those articles made in England.

Luxuriant crops of flax are frequently raised in Scotland; but no body will affirm, that the flax is ever equally good in quality with what is produced on the rich soils of Holland, or in the fens of Lincolnshire. During the late American war, the trustees

tees for manufactures in Scotland gave ample encouragement for raising flax seed, which occasioned its being often sown on poor Moorish soils; the flax that grew upon these soils was of so miserable a quality, that the farm cattle were generally littered with it, in order to convert it into manure.

Kentish cherries, the golden pippen, or apples of any other kind, will grow equally large in Scotland as in the southern provinces of England; but no body will dispute that they are ever as sweet and high-flavoured, or that an equal quantity of spirits could be extracted from the fermented juice of these fruits, the growth of the respective countries.

Barley which grows upon the poor soil, and in the cold climate of Scotland, is frequently equally heavy with what is produced on the fertile soil, and in the warm climate of England; but, like other plants,

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it is always deficient in those rich materials which are afforded by the united influence of a warm climate and fertile soil, which, by the powers of vegetation, are converted into saccharine juice, when the barley is either lodged in the soil, or made into malt; and in proportion to the quantity of sugar contained in it, ale or spirits may be extracted, but by no means in proportion to the weight of the malt or barley *.

Scots

* As a further proof of this fact, I adduce the following evidence :

A good number of years ago, an eminent brewer in Leith (an Englishman) was boasting, to the late David Loch, of the superiority of English to Scots barley. This superiority Mr Loch was pleased to deny, alledging that Scotland produced as heavy barley as England; the Englishman refused his assent to this assertion, and a wager took place betwixt the gentlemen, each for the honour of his respective country. Mr Loch accordingly produced barley from the shire of Moray, which, to the Englishman's astonishment, out-weighed his fine English grain. He would not, however, allow the wager to be determined, as the matter then stood. The

two

Scots barley is generally heavier, plumper in the grain, and contains more meal than the barley of the growth of Poland, which is always imported in such quantities into

two parcels of barley were carefully malted, and an experiment was made to discover which of them would produce the greatest quantity of spirits. Mr Loch was now humbled in his turn ; for the English barley produced a considerable quantity of spirits more than the Scots.

The following Letter refers to the above transaction.

S I R,

I WAS disappointed at not seeing you in Edinburgh yesterday, to communicate the information you desired me to procure from Mr Cundle, which is to the following purport :—That, above twenty years ago, in consequence of a dispute with the late Mr David Loch, he weighed a boll of good Morayshire barley, and a boll of Norfolk barley, also of a good quality, imported

into this country, whenever the ports are opened ; but brewers and distillers have hitherto uniformly declared, that it always produced more ale and spirits than the best barley in Scotland,

Scots wheat is not so defective in meal or in weight, when compared with English or Polish grain ; as, to use the bakers language, it never springs so well ; in other words, that, when the yeast is mixed with the dough, there is never so great a fermentation

ted from Lynn, that the former exceeded the latter a full stone ($17\frac{1}{2}$ averdupois pounds) ; he then malted equal quantities of each of these cargoes, to which, in the whole process he paid equally great attention, that the English barley malted well, but a great deal of the Scots barley remained flinty, which he could ascribe to no other cause than a want of sun ; upon further comparing their qualities in distilling, &c. he is of opinion, that even that heavy Morayshire barley was half a-crown per boll inferior in quality to the Lynn barley,

I am yours', &c. J. B.

Leith, March 30. }
1786. }

mentation produced, which probably may be ascribed to the same cause, viz. a deficiency of saccharine matter, in the wheat of the growth of Scotland.

From the facts which have been stated above, it appears highly probable, that the nourishing quality in plants is increased by the joint influence of a warm sun and fertile soil ; and that barley produced in Scotland, although equally weighty, contains less of those rich materials, which are converted into saccharine matter, upon being made into malt, than the growth of England, or other more warm and fertile countries.

I shall now proceed to illustrate the second object in view, and point out the causes which prevent the extracting of the rich materials contained in barley, by the arts of brewing and distillation. These, as was before observed, must be first converted into saccharine matter, either by the

the more compleat powers of vegetation, when the barley is made into malt, or by the less perfect process of fermentation; it therefore becomes necessary to explain the process of malting, by which the sugar is produced, which is as follows:

After the barley has been soaked in water, till it is sufficiently saturated, it is taken out and allowed to vegetate; the roots come out of that end of the grain which was formerly attached to the ear; the blade springs from the same end, pushes along the back of the grain, within the husk, and appears at the other end. As soon as the blade begins to sprout, that end of the grain from whence it springs is converted into malt, and a change takes place, in proportion as the blade advances along the grain, and the whole is converted into malt, and the greatest quantity of saccharine matter formed precisely at the period when the blade has reached the other end of the grain, and is just beginning to make its appearance.

ance. At this critical period, the vegetation must be stopped, otherwise the saccharine juice would be extracted by the blade from the malt, and the qualities of it hurt ; if it should be stopped before the blade reaches the end of the grain, that part of it only is turned into malt as far as the blade had advanced, the remaining part continuing in its original state.

It is therefore obvious, that, to make barley the most productive possible, either in the brewery or distillery, it is absolutely necessary, that, when it is made into malt, every grain should begin to vegetate and push out the blade exactly at the same time ; so that, when vegetation is stopped, all the grains may be totally converted into malt, and the largest quantity of saccharine matter formed, by which the quantity of ale or spirits that can be extracted from the malt is determined. For producing this effect, it is absolutely necessary, that every grain of the barley malted at an operation, should
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be equally ripened, and dried with the genial heat of a warm sun ; that it should grow upon a soil uniformly rich, and of the same elevation, and, above all, should be free from the injuries of autumnal frosts, or rain in harvest.

It will therefore be easy to point out the reasons which even prevent the small proportion of rich materials, which barley in Scotland imbibes, from the less powerful influence of the climate and soil on which it grows, from being converted into saccharine juice in the process of malting, and which altogether renders malt, of the growth of this country, in a particular manner so much inferior to the produce of England, and other warm and fertile countries ; its unequal vegetation resulting from the following conspicuous causes, viz.

The mountainous face of the country, and its being intersected with a number of
friths

friths and lakes, occasioning copious exhalations, which, when they are condensed by the returning cold in autumn, produce much rain in harvest, which more or less damages a considerable portion of the grains of barley, either before it is cut down, or in the shock, and obliges the Scots farmers to hurry their crop into the barnyard, before it is thoroughly or equally dried, frequently, by the most careful and judicious farmers, in so damp a state, that so great a heat and fermentation is brought on, which either materially injures, or perhaps totally destroys its vegetative qualities.

From the northern situation of the country, by which means these watery exhalations are frequently converted into hoar frosts in autumn, which benum the *
germ

* The germs of plants, and particularly of barley, are easily hurt by frost, before the seeds are perfected; frosts in Scotland are common during the night, after the

germ in the grains of barley, more or less as they are exposed to the frost.

From the inequality of the surface of the country, the air, when cooled by frost,
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the beginning of August ; but the intenseness of the cold in the same night is exceedingly various, even in adjoining fields. Sometimes the frosts attack the plants in hollow grounds, and at other times on the heights. In September 1784, there was a stream of frost in East Lothian, which totally destroyed the stems and leaves of the potatoes, from the shore to perhaps about the height of 800 feet above the level of the sea ; the pods of all the pease growing upon a well sheltered low lying farm, within the tract, were damaged by the frost, whilst those that were growing in more exposed situations on all sides were not hurt. Upon advancing higher into the country, even to the top of Soutrahill, on the heights of Lamermoor, the leaves of the potatoes were not in the least affected. In June 1785, there was a frost in East Lothian which destroyed the leaves of the ash trees, and of the plantain or rib-grass, in particular situations. In Scotland, where the surface of the country is unequal, the richest soils, for the most part, lie in the valleys, through each of which there generally runs a rivulet, the ground in these valleys being
much

is divided into a number of currents, increasing the intensity of the autumnal cold in particular cultivated fields and tracts of country, and lessening it in others.

From the sudden and abrupt manner in which the country rises above the level of the sea, frequently occasioning a perceptible change of climate, every second or third mile from the shore, and from the irregularity of the soil, both in point of fertility and exposure to the influence of the sun, which altogether occasion the crops to ripen very unequally.

Owing

much heated through the day occasions a copious evaporation during the night, which cools the air to such a degree as often to occasion frost. The farmers on Gala water, in Mid Lothian, were formerly in the practice of sowing their pease on the richest grounds adjoining to the water; but they were almost constantly destroyed with the frost; they now sow them on their more exposed grounds with better success. In a low situation in East Lothian, on the 4th of March, this present year, at seven in the morning, the mercury in the thermometer stood at 14 degrees below the freezing point.

Owing to the causes pointed out in the preceding pages, the barley produced in Scotland is so various in quality, that the growth of each field, and frequently of different parts of the same field, always appear stamped with a different character, either in point of weight, colour, shape, plumpness, or meagerness of the grain; it is therefore obvious, that when this heterogeneous mass is heaped together in a granary, and afterwards made into malt, it is absolutely impossible that the grains of barley should begin to vegetate at the same time, or push on the blade with an equal degree of vigour. Accordingly, when it is found necessary to stop vegetation in the making of malt of the growth of Scotland, numbers of the grains may be discovered which have not begun to vegetate, whilst some are just beginning, and others have only pushed the blade half way to the other end of the grain. From these causes, Scots malt is also rendered less productive than that of England, or other warmer countries.

countries ; where the barley grows upon a rich champaign soil, free from autumnal frosts, and the hazard of wet weather in harvest, and where it is carried to the threshing floor, after every grain of it has been thoroughly ripened and equally dried with the more powerful influence of a brighter and warmer sun.

That the bad effects arising from the causes pointed out in the first and second sections of these Disquisitions do actually occasion a considerable inferiority in the quality of Scots malt, appears evident from the conduct of the brewers and distillers in the city of Edinburgh, and other parts in Scotland, who, since the additional duty on malt took place, declared they could not pay the high malt duty for the growth of Scotland, and are now supplied for the most part from the port of Lynn in Norfolk. But, although this barley is accounted of an inferior quality in England, and therefore seldom goes to London, that
market

market being supplied from the more southern counties ; and what grows upon the rich soils in Norfolk is shipped from the port of Yarmouth : Yet distillers in Scotland have been known to affirm, that they could draw two gallons of spirits from a boll of it, more than from the best barley they had ever manufactured of the growth of Scotland. Brewers have also corroborated the fact, by declaring that malt from English barley will give flavour to a larger quantity of worts than Scots, and that the ale produced from it is of a superior quality. Lynn barley can be brought at present into any port in the Frith of Forth, at the expence of about 15 d. *per* boll. Perhaps, when Great Britain has recovered her shipping, and the freights are reduced to their old standard, it may be brought down for one shilling. If English barley of an inferior quality, brought from the port of Lynn, produces two gallons of more spirits than the best of Scots barley, the superiority of the generality of English

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barley

barley over the growth of Scotland, whilst the present high duties on the produce of barley exists, may be moderately estimated at from eight to ten shillings *per* boll, Linlithgow measure. This assertion seems well founded, and is supported by the following evidence:—Barley of the growth of Fife is esteemed better in quality than the *medium* produce of Scotland. This county, in a manner surrounded by the sea, and full of excellent ports, is most commodiously situated for transporting grain to the best markets in Scotland, and particularly to the port of Leith. The corn measures used in Fife are so much larger than the Leith measure, that the difference fully indemnifies the expence of freight and charges. Lynn barley sold in Leith, from the month of October 1785 to the 1st of March 1786, on an average at 19s. *per* boll, Leith measure, whilst Fife barley might have been received by the same measure at that port during the same period, for payment of ten shillings and ten pence, being the fiars of the
county

county for crop 1785.—The brewers and distillers, however, preferred the Lynn barley at eight shillings and two pence *per* boll of additional price, although in England it is esteemed of an inferior quality, and for which they must have received value in return, otherwise they would have formed more extensive connections with the farmers in Fife, the most natural market of the two. The malt duty on a boll of barley in Scotland runs from three shillings and nine pence to four shillings *per* boll, Linlithgow measure, and double in England: But, from what has been stated above, it appears, from the most moderate calculation, that, when Scots barley is charged with four shillings of duty *per* boll, English barley, on account of its superior quality, is equally well able to bear from 10 s. to 12 s. It seems therefore evident, that malt of the produce of Scotland is much higher taxed in proportion to its quality than malt of the growth of England; and this accounts for the present
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predilection of the brewers and distillers in Scotland in favours of English barley. The allowing them, however, to bring it down, and malt it at the Scots duties, is an indulgence which they are by no means entitled to ; it is expressly contrary to the intention of the legislature in relieving Scotland of the half of the malt duty, on account of the inferior quality of Scots barley. It is a favour which is at present proving ruinous to the farmers in Scotland, is every day becoming more hurtful to the revenue, and in the end must fall upon the proprietors of land in this country.

From the facts which have been stated in the preceeding Disquisitions, the following inferences may be drawn.

First, That the Excise laws presently in force for raising a revenue on corn-spirits, by levying the duty on the *wash*, having been adapted to suit the quality of that liquor, richly impregnated with saccharine juice

juice from the fine grain of England, whenever they are enforced with rigour in Scotland, they become highly oppressive to the landed interest and farmers, by obliging the brewers and distillers to give over making use of a * great part of the barley produced in this country, on account of the small quantity of saccharine matter which it contains.

Secondly, That, as the malt tax in Scotland is higher rated in proportion to the quality

* This will appear evident upon inspecting the general account at the custom-house, of the quantity of English barley imported into Scotland since the year 1781, when the additional duty on malt was laid on. The imports of barley from England into the port of Prestonpans, in East Lothian, alone, stands thus :

For ten years preceeding 1780 641 quarters.

1781 358

1782 2439

1783 4237

1784 6756

1785 7950

quality of the grain, than in England, and consequently the making Scots corn spirits or ale, when sent into England, pay a duty on the supposition that it is lower rated, would, in place of an * equalizing duty, be crushing a manufacture which is already overloaded.

Thirdly, That, the laying on an additional malt-tax on barley of the growth of Scotland (a † measure which has been recommended

* Vide 8th Resolution of the Committee of the Landed Interest in Scotland on the Distillery, viz.

Resolved, That an equalizing duty should be imposed upon spirits distilled in Scotland, when sent to England, to make up the difference of the lesser malt-duty paid in Scotland than is paid in England.

† It has been proposed to commute the tax on salt, and the coasting duty on coals in Scotland, in order to encourage the fishery, by laying on an additional 3 d. per bushel on malt. I am well pleased that Mr Robert Fall merchant in Dunbar, a gentleman of great experience,

commended to Parliament) would be extremely hurtful to the agriculture of this country, by obliging the brewers and distillers totally to reject barley of the produce of Scotland.

Fourthly, That imposing the malt-tax in proportion to the weight of the malt would

rience, and the most extensive maker of malt and corn dealer in Scotland, coincides with me on this point; and, as his opinion may strengthen the conclusions drawn from the preceding disquisitions, I have taken the liberty to set it down at full length, as taken from the 73d page of his observations on the report of the Committee on the fishery, as follows, viz :

Commutation on Malt,

“ It is proposed that the commutation on salt and
 “ coals be laid on this article; I advise every wellwisher
 “ to his country to beware of such a plan; it has ever
 “ with justice been said, that the barley in Scotland
 “ is of such an inferior quality as not to be an object of
 “ taxation, when compared with the English barley,
 “ and this tax will fall heaviest on the north country,
 “ which it is meant to serve, on account of the still
 “ greater inferiority of their grain.”

would prove an unequal mode of levying the duty when applied to the barley of the growth of Scotland, as it does not contain saccharine matter in proportion to its weight * ; whilst, by rendering the collecting of the malt-tax more complicated, it would be only opening another door through which the revenue would be carried off.

And, *lastly*, As the inferior quality of Scots barley has hitherto proved a great temptation

* Although good Scots barley has been found heavier than English by 17 1-half pounds per boll, being equal to 23 pounds per quarter, and at the same time containing less saccharine matter ; nevertheless, Scots barley is in general also defective in point of weight, and more so than any of the other grains. The effect of climate on tares is very remarkable ; when they come down from the London market, they are small and round ; but, after they have been sown a few years in Scotland, they increase to double their original size, and consequently contain more meal, and, from being nearly round, acquire a flat compressed shape.

temptation to evade the present high duties, it seems expedient, for improving the revenue, that government should lay on the English malt-duty on all English and foreign barley imported into Scotland; that distillers should be prevented from using barley in distillation before it has been malted, and the tax paid; that the duty on corn spirits should be lowered by imposing a moderate tax on the contents of the still, and the *minimum* or smallest enterable size of the still ought to be brought down from 400 to 30 gallons, the last mentioned size being better suited to the capitals and accommodation of the distillers and farmers in Scotland, a few great ones excepted. By such regulations, HONEST MEN would be encouraged to engage in the trade, and occasion a competition in the sale of spirits amongst the distillers; by which means their present mode of defrauding government of the greatest part of the duties, whilst they are levying them from the public, by keeping up the price of spirits,

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would

would be intirely stopped ; the community would in course be served with cheaper and better home made spirits ; the smuggling of foreign spirits would be effectually prevented, AND GOVERNMENT WOULD RECEIVE A MUCH LARGER REVENUE FROM MALT AND CORN SPIRITS THAN HAS HITHERTO BEEN COLLECTED IN SCOTLAND.



